Courses content of the third semester at ULiège

Course title: Biological chemistry and corresponding processes engineering

Key words	Processes, industrial processes, biological molecules
Aims	The course aims to address the application of biological chemistry and related industrial processes through group-based projects (in Problem-Based Learning).
Content	In this course, students will be able to design a complete pathway for the upgrade of an organic (vegetal) material into a specific application by selecting and optimizing the transformation paths. The targeted molecules are conventional biopolymers (starch, cellulose, hemicelluloses, proteins, lignins, etc.) or primary metabolites. For security reasons, access to the laboratory is authorized only for Students with a lab coat, their safety glasses and in order of registration. Glasses should be worn when handling.
ECTS	**6 ECTS**
Skills	Knowledge and understanding For a passing grade the student must • Be able to apply a logical technical protocol to convert a starting (plant) organic material into a given application and thus **design the entire value chain** • **Use analytical techniques for the characterization of biological molecules** in order to monitor, calculate and predict the biomass composition variability, conversion yields, product purity, etc. • Students should be able to approach the **flow sheet concept** applied the processes used in their research project (flow sheet design, yield calculation, mass balance, parameter optimization, energy and environmental impacts, etc.) Competences and skills For a passing grade the student must • Understand a bio-process and define its operational constraints; recognize and describe in its components a bioprocess; Judgement and approach For a passing grade the student must • Design new chemistry and applied biology processes: green and white biotechnologies, biocatalysis, biosourced products, bioremediation, biomedical applications; • Identify existing processes in the fields of life chemistry and biotechnology; Evaluate the performance of existing bioprocesses
Complementary skills	Write a document in English adapted to the target audience on a complex subject

Module Coordinator(s)	Richel Aurore
Teaching staff	Richel Aurore
Language of instruction	English
Nb hours of lectures	4
Nb hours of practical work	37
Nb hours of tutorials	-
Nb hours of personal work	Included in the 37 hours of practical work
Nb hours of other	-
Length of the internship in weeks	2 weeks
Bibliography recommended	Papers in International Journals; bibliography available at the library of the Biomass and Green Technologies Lab (ULIEGE)
Prerequisites	None
Teaching period (when)	Mid-september
Place of teaching (where)	Gembloux
Assessment	Personal work (report) – 100% Note: the presence during the practical session is mandatory

Course title: Practice of the chemistry of natural substances

Key words	Natural resources, green chemistry, extraction
Aims	The course is centered on the thorough study of one or several natural products included in a biological matrix. The main objective of this course is to increase knowledge in organic analysis (extraction processes, purification and identification of natural molecules), in chromatographic and spectroscopic methods.
Content	This course is centered on the achievement of a group work in the laboratory and relies on the following steps: 1- Definition of the research project 2- Up-to-date bibliographic search (state of the art) 3- Preparation of the working strategy and main tasks (oral presentation in English) 4- Achievement of the project in the laboratory 5- Drafting of a synthetic report on the project and the results
ECTS	**4**
Skills	Knowledge and understanding For a passing grade the student must • Be able to present a research project describing how to use synergistically the extraction, purification and identification (physical as well as chemical) techniques of organic molecules contained in complex biological matrixes. • Be able, antonomously, to carry out the project in the laboratory and to to use, in synergistic manner, the techniques of extraction, purification and identification of organic compounds

	• Be able to identify organic molecules contained in complex biological matrices using chromatographic and spectroscopic methodologies. Competences and skills For a passing grade the student must • Identify the flows and technical aspects related to a production line or process • Implement and manage projects to ensure the quality and safety of bio-products • Manage a food, non-food or biopharmaceutical production chain Judgement and approach For a passing grade the student must • Design technological solutions aimed at the food and non-food valorization of bioresources in a sustainable perspective • Determine the unit steps and operations of an existing manufacturing or processing process to identify constraints • Adapt an existing manufacturing or processing process to a new context
Complementary skills	Present the results of a R&D initiative in English adapted to the target audience on a complex subject
Module Coordinator(s)	Richel Aurore
Teaching staff	Richel Aurore, *N…*
Language of instruction	English
Nb hours of lectures	3
Nb hours of practical work	35
Nb hours of tutorials	-
Nb hours of personal work	35 (included in the number of practical work)
Nb hours of other	-
Length of the internship in weeks	1 week
Bibliography recommended	-
Prerequisites	None
Teaching period (when)	October
Place of teaching (where)	Gembloux
Assessment	Personal report presented in English at the end of the lessons (oral evaluation 100%). The presence in the laboratory is mandatory.

Couse title: Microbial biotechnology – applications

Key words	Microbiology, fermentation, industrial processes
Aims	At the end of this multidisciplinary module, students will be able to develop the different aspects of the development, implementation, optimization and control of a production process for a compound of interest in bioreactor.

Content	To approach in a practical way the technologies for the production of compounds of biotechnological interest (biomass, proteins, metabolites) developed in the agri-food and bio-pharmaceutical industries. The course will detail different examples of biotechnological applications based on the use of microorganisms (yeasts, bacteria).
ECTS	**6 ECTS**
Skills	Knowledge and understanding For a passing grade the student must • be able to develop the different aspects of the development, implementation, optimization and control of a production process for a compound of interest in a bioreactor Competences and skills For a passing grade the student must • Describe and analyse a product, understand and explain a process in the field of life chemistry and bio-industries in an evolving context • Rigorously apply a provided analytical protocol, generate results and interpret them using known methodologies Judgement and approach For a passing grade the student must • Understand a bio-process and define its operational constraints • Establish a relationship between the constraints and components of a bioprocess in order to improve its performance • Implement high-performance analytical methodologies adapted to specific situations
Complementary skills	Write a document in English adapted to the target audience on a complex subject
Module Coordinator(s)	FICKERS Patrick
Teaching staff	DELVIGNE Frank, FICKERS Patrick, JACQUES Philippe, ONGENA Marc
Language of instruction	English
Nb hours of lectures	10
Nb hours of practical work	44
Nb hours of tutorials	-
Nb hours of personal work	44 (included in the numbers of hours of practical work)
Nb hours of other	-
Length of the internship in weeks	-
Bibliography recommended	Articles from the scientific literature
Prerequisites	None
Teaching period (when)	October-December
Place of teaching (where)	Gembloux
Assessment	Personal report and oral examination

Course title: Portfolio (innovative economical activities development)

Key words	Economy, personal development, personal work, start-up
Aims	The "skills portfolio" is a pedagogical device designed to enable students to refine the construction of their psycho-social skills (mainly communication, leadership, entrepreneurship, group management ,..) exclusively) that they must acquire in the context of their professional project.
Content	This course relies on two learning modes (selected by the student at the beginning of the activity): either a participation in a workshop organised within ULiege - Gembloux Agro-Bio Tech (and designed to work on skills such as communication, leadership, entrepreneurship, group management, etc.) or the realization of a personal or group project, i.e. learning by doing. In this case, a jury must determine whether the project strengthens the skills worked on in the workshops.
ECTS	**2 ECTS**
Skills	Knowledge and understanding For a passing grade the student must • Manage a project, and defend its content, related to a socio-economic and technical issue. • Animate a team and to demonstrate leadership in case of group projects Competences and skills For a passing grade the student must • Animate a team • Manage projects, a company, carry out a technical-socio-economic study and analyse their impact on society and its environment • Implement, in order to regulate, the steps for achieving the socio-economic and environmental objectives of a technical project Judgement and approach For a passing grade the student must • Build skills and critical thinking skills • Maintain and develop your skills; take a critical look at your action
Complementary skills	Lead and motivate a multidisciplinary and diverse team, manage conflicts and demonstrate leadership
Module Coordinator(s)	DEGRE Aurore
Teaching staff	BECKERS Yves, CLAESSENS Hugues, COLINET Gilles, DEGRÉ Aurore, SINDIC Marianne
Language of instruction	English
Nb hours of lectures	-
Nb hours of practical work	-
Nb hours of tutorials	-
Nb hours of personal work	24

Nb hours of other	-
Length of the internship in weeks	-
Bibliography recommended	None
Prerequisites	None
Teaching period (when)	To be defined
Place of teaching (where)	Gembloux
Assessment	Personal work (100%)

Course content: Chemistry of bioenergy production

Key words	Chemistry, biofuels, alternative fuels, energy
Aims	This course, based on the concept of PBL (problem-based learning) is aiming at studying (from a theoretical point of view associated to the execution of a personal project in the lab) the main technologies for energy production from renewable resources with a focus on the chemical options.
Content	This course will underline the main concepts (from a chemical point of view) for energy production using biomass including biogas (methane) production, thermochemical approaches (gasification, pyrolysis, etc.) with upgrade options (ie. Fischer Tropsch, etc.), biofuels production including biodiesel, bioethanol, kerosene, alternative fuels, etc. Production of hydrogen and energy vectors from biomass.
ECTS	**7 ECTS**
Skills	Knowledge and understanding For a passing grade the student must • Be able to apply a logical technical protocol to convert a starting renewable inflow into a given energetic application and thus **design the entire value chain** • Use analytical techniques to estimate conversion yields and outflows purity and quality • Students should be able to approach the **flow sheet concept** applied to an energetic conversion process (flow sheet design, yield calculation, mass balance, parameter optimization) and to estimate the overall energy and environmental impacts Competences and skills For a passing grade the student must • Understand a bio-process and define its operational constraints; recognize and describe in its components a bioprocess; • Analyze a chemical or biochemical process and to define its constraints Judgement and approach For a passing grade the student must

	• Design new chemistry and applied biology processes: green and white biotechnologies, biocatalysis, biosourced products, bioremediation, biomedical applications; • Identify existing processes in the fields of life chemistry and biotechnology; Evaluate the performance of existing bioprocesses
Complementary skills	Write a document in English adapted to the target audience on a complex subject
Module Coordinator(s)	RICHEL Aurore
Teaching staff	RICHEL Aurore, *N*
Language of instruction	English
Nb hours of lectures	4
Nb hours of practical work	40
Nb hours of tutorials	-
Nb hours of personal work	40 (included in the Nb of practical work)
Nb hours of other	-
Length of the internship in weeks	2 weeks
Bibliography recommended	Articles from the scientific literature
Prerequisites	None
Teaching period (when)	October
Place of teaching (where)	Gembloux
Assessment	Personal work (report) 100%